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Original Research Article

Risk Factor of Multiple Myeloma in Relation to Occupational Exposure to Radiation: A Hospital Based Study at Gauhati Medical College & Hospital, Guwahati, Assam

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ABSTRACT

Background: The risk factors for multiple myeloma (MM) are not conclusive, because the cause of MM is not clearly known. Researchers believe that MM is most likely the result of many risk factors acting together. Despite recent advances in clarifying the biological mechanisms of MM, there are no established risk factors so far other than factors like male gender, increasing age, African American ethnicity, positive family history of lymphatohematopoietic cancer (LHC) and monoclonal gammopathy of undetermined significance (MGUS). Several studies have shown that during world war people who were exposed to radiation from an atomic bomb blast had a higher risk of developing MM. Other studies also suggests its association with occupational exposure to radiation, but not conclusive. This study aimed to investigate the association between occupational exposure to radiation and development of MM.

Methods: This study is based on studies conducted on Risk Factor of Multiple Myeloma with Occupational Exposure to Radiation - A Hospital Based Study at Gauhati Medical College & Hospital, Guwahati, Assam. A total of 100 cases were studied in the Out Patient Department (OPD) of the Clinical Haematology Department, Gauhati Medical College & Hospital, and Guwahati, Assam. Being a descriptive study, the data were procured from the OPD of the same department

Results: In the present study 75 (75%) had no history of exposure; 20 (20%), 4 (4%) and 1% patients had history of X-ray, CT scan and professional exposure of radiation. there exists a significant difference ($p<0.0001$) in the number of patients belonging to the two groups, exposure to radiation and non-exposure. Also there exists a significant difference ($p<0.0001$) in the number of patients with reference to exposure to different types of radiation.

Conclusions: Factors with significant risk for development of multiple myeloma are – X-ray exposure for more than four years.

Keywords: Myeloma, Occupational Exposure, Pesticides, Radiation.

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INTRODUCTION

Multiple myeloma (MM) is a clonal plasma cell neoplasm characterized by the proliferation of plasma cells in the bone marrow, monoclonal protein, osteolytic bone lesions, renal disease, and immunodeficiency. It accounts for 15% of lymphatohematopoietic cancers (LHC) and 2% of all cancers in the US. MM is the most important class which is included under plasma cell dyscrasias. More importantly, delineation of the mechanisms mediating plasma cell proliferation, survival and migration in the bone marrow microenvironment may enhance the understanding of pathogenesis, and a better understanding of the molecular pathogenesis is fundamental for developing more effective prognostic, therapeutic and preventive approaches.

MATERIALS AND METHODS

This study is based on studies conducted on Risk Factor of Multiple Myeloma with Occupational Exposure to Radiation - A Hospital Based Study at Gauhati Medical College & Hospital, Guwahati, Assam. A total of 100 cases were studied in the Out

Patient Department (OPD) of the Clinical Haematology Department, Gauhati Medical College & Hospital, and Guwahati, Assam. Being a descriptive study, the data were procured from the OPD of the same department.

Research Type: Hospital based cross-sectional descriptive study.

Study Setting: The present study has been undertaken in the Out Patient Department of the Clinical Haematology Department of Gauhati Medical College & Hospital, Guwahati, Assam.

Study Period: The study period was three years commencing from November, 2010 to October, 2013.

Study Population: The study population comprise of 100 numbers of newly diagnosed cases of multiple myeloma attending the OPD of the Clinical Haematology Department of Gauhati Medical College & Hospital, Guwahati, Assam during the period of November, 2010 to October, 2013. Before undergoing the study clearance from institutional ethical committee was obtained. Analysis of data was done in the year 2014-15.

The Sample: Sample size of 100 number of newly diagnosed multiple myeloma patients were taken into the study.

Selection of Cases: We have taken all the newly diagnosed cases of multiple myeloma into the study attending at OPD of the Clinical Haematology Department of Gauhati Medical College & Hospital, Guwahati, Assam during the period of November, 2010 to October, 2013. Initially patients were selected purely on clinical ground and then negative cases were excluded after diagnosis based on International Myeloma Working Group (IMWG) criteria for diagnosis of monoclonal gammopathies.

Inclusion Criteria: One hundred newly diagnosed cases of multiple myeloma of all age groups.

Exclusion Criteria: (1) Old diagnosed cases of multiple myeloma that are under treatment. (2) Monoclonal gammopathies of undetermined significance (MGUS) (3) Asymptomatic (smoldering) multiple myeloma.

Protocol: The proforma was prepared based on universal standard protocols for evaluation of multiple myeloma which contains separate history, examination and investigation parts. The International Myeloma Working Group (IMWK) criteria for classification of monoclonal gammopathies, multiple myeloma and related disorders were used for diagnosis of the disease. During the study period Immunofixation electrophoresis test (for serum/urine) was not available in the institute. So this test was not included into the study. Then staging was made according to International Staging System (ISS).

Performance status of patients was made according to Eastern Co-operative Oncology Group (ECOG) standard performance protocol (Appendix-1).

Methods: Details of the patient - Details of the patients were recorded in the manner in order of age, sex, religion, caste, occupation, address, hospital number and registration number for identification and documentation. When patients were first examined a detailed history was taken and thorough clinical examination was done. Then they underwent a battery of investigations to confirm diagnosis. All the patient's history, clinical examination, investigation findings, and diagnosis data were recorded in a pre-designed and pre-tested proforma.

Statistical Analysis: Data were analysed using statistical package and results and observations were presented in tabular form. Statistical tests were applied wherever required.

Table 1: Distribution of history of exposure to different diagnostic radiation of the patients (N=100)

History of Radiation exposure	Males		Females		Total	
	No.s	%	No.s	%	No.s	%
X-ray	12	17.91	8	24.24	20	20
CT-scan	2	2.99	2	6.06	4	4
Professional exposure	1	1.49	00	00	1	1
No exposed	52	77.61	23	69.70	75	75
Total	67	100	33	100	100	100

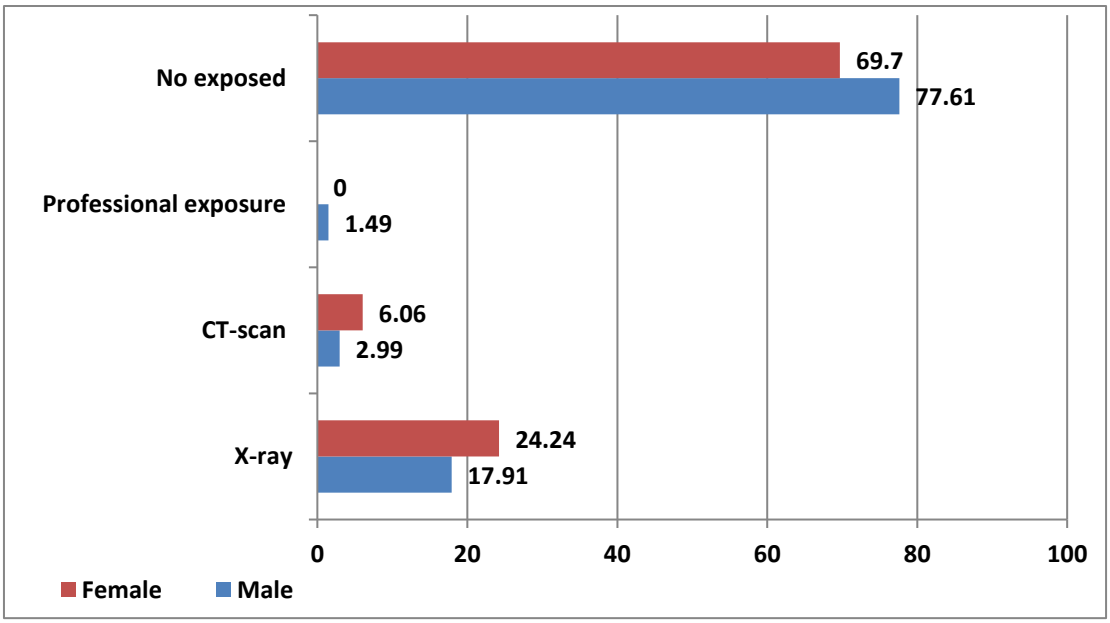

Figure 1: Bar diagram showing distribution of exposure to different diagnostic radiation of the patients

Table 2: Distribution of duration of x-ray exposure (diagnostic) of the patients

Duration of x-ray exposure	Males		Females		Total	
	No.s	%	No.s	%	No.s	%
1-2 years	1	1.49	2	6.06	3	3
2 – 4 years	4	5.97	2	6.06	6	6
> 4 years	7	10.45	4	12.12	11	11
Not exposed	55	82.08	25	75.76	88	88
Total	**67**	**100**	**33**	**100**	**100**	**100**

Figure 2: Bar diagram showing distribution of duration of X-ray exposure of patients (Diagnostic)

Table 3: Distribution of frequency of X-ray exposure (number of shots) in six months

Frequency of X-ray exposure (shots)	Males		Females		Total	
	No.s	%	No.s	%	No.s	%
5 – 10 times	8	11.94	4	12.12	12	12
11 – 15 times	2	2.99	2	6.06	4	4
16 – 20 times	1	1.49	1	3.03	2	2
21 – 25 times	1	1.49	1	3.03	2	2
No exposed	55	82.08	25	75.76	88	88
Total	**67**	**100**	**33**	**100**	**100**	**100**

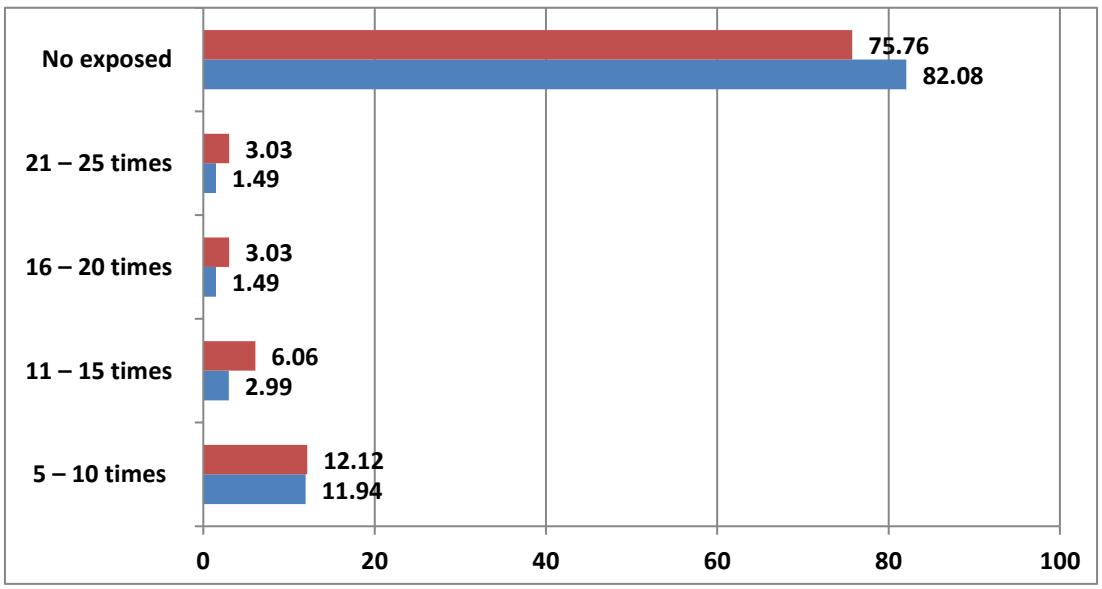

Figure 3: Bar diagram showing distribution of frequency of X-ray exposure (number of shots) in six months.

RESULT AND OBSERVATIONS

Past History of Radiation Exposure

Table-1 (and Figure-1) shows that 75 (75%) patients had no history of any radiation exposure, 20 (20%) patients had history of X-ray exposure, 4 (4%) patients had history of CT scan exposure and one (1%) patient had history of professional exposure to radiation. The statistical analysis from the table-1 reveals that there exists a significant difference ($p<0.0001$) in the number of patients belonging to the two groups, exposure to radiation and non-exposure. A significant number of patients were not exposed to any kind of radiation. Also the statistical study on the exposure group reveals that there exists a significant difference ($p<0.0001$) in the number of patients with reference to exposure to different types of radiation. Among them a highly significant number of patients were exposed to X-ray. (Test statistics: 'Z' test for differences of two proportion, calculated value of 'Z'=6)

Table-2 (and Figure -2) shows that 11 (11%) patients had history of X-ray exposure for more than 4 years, 6 (6%) patients for 2 to 4 years and 3 (3%) patients for 1 to 2 years. However, 88 (88%) patients had no history of X-ray exposure. The statistical analysis from the table-2 reveals that among the patients having X-ray exposure, those who had X-ray exposure for more than 4 years are significantly ($p=0.08$) venerable to the prevalence of MM. (Test statistics: 'X^2' test for independences of attributes, calculated value of 'X^2' =4.9)

The table-3 (Figure-3) shows that 12 (12%) patients had history of X-ray exposure of 5-10 shots in six months, 4 (4%) patients of 11-15 shots, 2 (2%) patients of 16-20 shots and 2 (2%) patients of 21-25 shots in six months. The statistical analysis from the table-3 suggest there exists significant difference ($p=0.003$) in the number of patients with reference to frequency of X-ray exposure. Moreover, for male, mean value of frequency of X-ray exposure is 10.58 times with SD 4.94 and for female mean value of frequency of X-ray exposure is 12.12 times with SD 4.5. So, the effect of X-ray exposure for female is more than that of male and variation for male is slightly more than that female. (Test statistics: 'X^2' test for independences of attributes, calculated value of 'X^2' =13.6)

DISCUSSION

Past history of exposure to different radiation of the patients

In the present study 75 (75%) patients had no history of any radiation exposure, 20 (20%) patients had history of X-ray exposure, 4 (4%) patients had history of CT scan exposure and one (1%) patient had history of professional exposure to radiation. Statistical analysis reveals that there exists a significant difference ($p<0.0001$) in the number of patients belonging to the two groups, exposure to radiation and non-exposure. A significant number of patients were not exposed to any kind of radiation. Also the statistical study on the exposure group reveals that there exists a significant difference ($p<0.0001$) in the number of patients with reference to exposure to different types of radiation. Among them a highly significant number of patients were exposed to X-ray.

Moreover, 11 (11%) patients had history of X-ray exposure for more than 4 years, 6 (6%) patients for 2 to 4 years and 3 (3%) patients for 1 to 2 years. However, 88 (88%) patients had no history of X-ray exposure. Statistical analysis reveals that among the patients having X-ray exposure, those who had X-ray exposure for more than 4 years are significantly ($p=0.08$) vulnerable for causation of MM.

Moreover, 12 (12%) patients had history of X-ray exposure of 5-10 shots in six months, 4 (4%) patients of 11-15 shots, 2 (2%) patients of 16-20 shots and 2 (2%) patients of 21-25 shots in six months. Statistical analysis suggest there exists significant difference ($p=0.003$) in the number of patients with reference to frequency of X-ray exposure. Moreover, for male, mean value of frequency of X-ray exposure is 10.58 times with SD 4.94 and for female mean value of frequency of X-ray exposure is 12.12 times with SD 4.5. So, the effect of X-ray exposure for female is more than that of male and variation for male is slightly more than that female.

Cogliano et al. (2011)[1] reported that that X- radiation and gamma radiation are classified by IARC as probable causes of myeloma, based on limited evidence.

Boice JD et al. (1991)[2] showed association between diagnostic radiation and MM.

Van Kaick G et al. (1999)[3] demonstrated that exposure to thorium dioxide (an X-ray contrast medium) have increase risk of Plasmacytoma more than 4-fold among patients examined with cerebral angiography or arteriography of the limbs.

Hatcher JL et al. (2001)[4] proposed no significant association between diagnostic radiation and multiple myeloma.

Our study findings are consistent with various other studies like those by Cogliano et al. (2011)[1], Boice JD et al. (1991)[2] and Van Kaick G et al. (1999).[3]

CONCLUSIONS

There exists a significant difference ($p<0.0001$) in the number of patients belonging to the two groups, exposure to radiation and non-exposure; a significant difference ($p<0.0001$) in the number of patients with reference to exposure to different types of radiation.

Radiation related factors with significant risk for development of multiple myeloma are:

(1) Exposure to X-ray for more than 4 years may be a risk factor for development of multiple myeloma.

(2) Risk of development of multiple myeloma is directly proportional to radiation dose.

RECOMMENDATIONS

(1) Some screening tests like detection of radiation exposure should be held periodically by the health agencies to detect the disease early specially in elderly people who are at risk of having environmental, occupational and life style factors for development of multiple myeloma. For this hospital should be well equipped with uninterrupted supply of materials necessity for early detection of multiple myeloma. Health agencies should be encouraged to organize periodic camps, health mela for screening of the disease.

(2) Environmental, occupational and life style factors which are risk for development of multiple myeloma should be included into the health education programmers so that the disease can be prevented. Information, Education and Communication (IEC) activities should be strengthened to disseminate these information to the people. Moreover, periodical orientation course to medical and paramedical staff should be undertaken.

(3) The study was a descriptive study. So any conclusions drawn will have to be guarded and will have to confirm with further trials in India.

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